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COTTON CULTIVATION IN CHINA

AND SOMETHING ABOUT THE SPINNING AND WEAVING MILLS

Being a reprint of a series of articles that appeared in "The North-China Daily News" (Shanghai) in September and October, 1916, revised and brought down to date.

SHANGHAI:
OFFICES OF THE "NORTH-CHINA DAILY NEWS & HERALD" LTD.
January, 1917

THE WORLD'S NEED OF MORE COTTON.

A Reuter telegram dated London, December 14, 1916, read as follows :—

> "Professor J. A. Todd, Professor of Economics, University College, Nottingham, in a paper read before the Royal Society of Arts on the cotton shortage, said that India was the only country from which there was any hope of obtaining an early increase of 1,000,000 bales a year of new cotton.
>
> "He had every reason to believe that India could maintain such an increase cumulatively till her present crop had, at least, doubled."

Prof. Todd's book, "The World's Cotton Crop" (1915), is a recognized standard work on cotton, and that he should hold the opinion that India is the only country on which the world can depend for an early increase of cotton production should be of interest in China just at this time as there is no reason why China, as well as India, should not produce her share of the world's cotton.

There is evidence that the world's production of cotton is not keeping pace with the increased rate of consumption. Taking a normal year before the war, for example, 1912-13, the consumption was 19,642,000 bales and the production 19,197,979 bales. The United States alone produces on the average 14,000,000 bales, in 1912 it was over 16,000,000. The 1916 crop in the United States is estimated at 11,500,000 bales only, and there are shortages in other countries, including Egypt, but not India. Cotton is now (January, 1917) over 10d. per lb., in November last it was over 12d., the highest since 1865, the American Civil War period. America ordinarily has about 6,000,000 bales (of 500 lb.) for export, but recently with the spinning and weaving mills greatly increased, the quantity for export is much reduced.

Evidently, to keep the supply up to the demand for manufactures, the world's annual crop must be increased by 1,000,000 bales, which, Prof Todd thinks, can be done in India where a great deal of land has been made available by irrigation in recent years. The 1916 Indian production was roughly 5,000,000 bales of three piculs, or about 500,000 more than in 1915. In other words, India is now producing approximately 4,000,000 American bales of four piculs, and Prof. Todd estimates she can eventually double that output, which would mean more than half the average American crop.

What can China do? An attempt to answer the question is made in the following pages, being a series of articles revised and reprinted from "The North-China Daily News" of September and October, 1916.

SHANGHAI, January, 1917.

A picul is 133⅓-lb.

I.

COTTON CULTIVATION IN CHINA.

How China Might Lead the World.

That China ranks third among the cotton-producing countries of the world is a fact not generally known.

The average crop of America may be said to be between 13,000,000 and 14,000,000 bales, that of India about 4,000,000 bales and steadily increasing in quantity and quality, and that of China is conservatively estimated to be in the neighbourhood of 2,000,000 bales. By "bales" is meant the American bale, roughly four piculs. So China to-day is producing, without any special effort, without help from her Government in the way of experimental farms, seed selection, or expert advice, a crop equal to a seventh of that of the United States. Experts who have made a study of cotton cultivation in China are of opinion that it would be no great task to make China the world's largest cotton-growing country. But one thing is needed—Government action.

HAPHAZARD CULTIVATION.

Official data concerning the amount of cotton grown in China is entirely lacking. There are no statistics whatever; and no one can say with any degree of positiveness what the crop amounts to as the acreage under cotton cultivation is unknown. Cotton is grown in such an absurd manner that it is difficult to estimate the real acreage in a given district. A patch of a few mow grows here, then a few mow of beans, then cotton again, and so on, with no large tracts devoted to cotton. But judging from the great quantities of cotton consumed in the country by the mills, the almost inestimable quantity used as wadding for bed and personal

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1 mow=⅙ acre

clothing, not to mention the comparatively small amount exported, it is estimated by those in a position to be informed of such matters that the production is in the neighbourhood of 2,000,000 bales.

If any real effort is to be made to better the quality of Chinese cotton and to increase the yield per acre, it will not only be interesting but most important to know, first of all, the approximate acreage now under cultivation. Such figures could be obtained by the Chinese Department of Commerce, or Agriculture, were those departments of the Government induced to take an interest in the matter, as the information could be got by means of reports from the various likin and tax offices throughout the country.

That China could be made the leading cotton-producing country of the world is no wild statement. Experiments made in the vicinity of Shanghai during the past few years show that the yield per mow can easily be increased threefold simply by selecting seed, by preparing the land in advance of planting, by the use of bean and other fertilizers within the means and reach of all Chinese farmers, and by properly weeding and caring for the plant from planting time until the plant has matured. The yield per acre could be trebled under ordinary scientific cultivation, and there is practically no limit to the extent to which the acreage might be increased. Acreage has been increased already to some extent, as it is known that much land formerly devoted to poppy-growing is now growing cotton, and farmers who are doing this will probably find that cotton is fully as profitable a crop as the poppy was in former times when opium was cheap.

THE QUESTION OF QUALITY.

There is no question but that the yield of cotton can be increased, but it is still a question whether the quality can be improved to an equal fineness as compared with the American product. The mills may always have to import American cotton for their finer work. Experiments, so far, with American seed in the Shanghai district have proved practically a failure; the plant grows well and thrives, but the summer season seems to be lacking by one month, for the weather becomes too cold before the bolls have opened. American cotton here goes back to the native Chinese plant in a year or two as the climate seems unsuitable. Experimenters, however, are not without hope of finding a means of acclimatizing American cotton and experiments conducted here in the summer of 1916 were nearer success than heretofore.

Yet Shansi cotton, which ranks as China's finest, is produced from American seed introduced by missionaries a few years ago, but even there, where it seems evident that the soil and climate are better suitable for the American plant than other districts, in three years the American cotton becomes almost identical with that grown from native seed. But, of course, no scientific attention is given to the crop.

Kiangchow is the natural and financial centre of a very extensive cotton-growing district in Shansi, and in 1898 capital to the extent of some Tls. 80,000 or more was raised by the local Shansi officials, a fine site by the side of the Fen river was secured and buildings, chimney stack, etc., were erected. By the time of the Boxer rising part of the machinery was already on the ground and the buildings were approaching completion. Owing to the upheaval of 1900, loss of machinery in transit, changes of officials and other causes, the whole concern collapsed. The chimney stack, power house and the fine compound call forth from every passer-by a lament for the "might-have-been" success of an enterprise in the heart of an important district, already growing China's best cotton.

Those interested in the improvement of Chinese cotton seem of opinion that the thing to do is to confine their experiments to the cotton already grown in China, and to work to the end of improving the quality and increasing the yield of the particular cotton already grown in a particular section of country. In doing this they will be profiting by the experience of the Growers' Association of South Africa who, some years ago, introduced American seed only to find that in three years' time the plant reverted to the old native stock. The American seed was a failure in Africa; yet American cotton originally came from Africa with the slaves. But the South African growers studied their soil, established experimental farms, and grew special seed scientifically, with the result that they improved the native plant so that South African cotton fetches a farthing a pound more than American cotton on the Liverpool market. Similar experiments conducted by the Government in Egypt likewise have been as successful.

Whether the day will come when China will do likewise depends much on the progressiveness of officialdom at Peking.

How the Earth is Overtaxed.

Mother Earth owes all men a living, even Chinese cotton growers; but the average Chinese farmer is not content that she should do just that. He expects her to be ever pregnant, to bear and bear and bear, always to produce, without rest, year in and year out. Mother Earth works for him eternally, she never gets a holiday; and the farmer aids her as little as he possibly can and what compensation he pays in the form of fertilizer is grudgingly paid. He is a hard taskmaster and forces her to bear doubly by planting a second crop even before she has borne the first. He gives her no chance to show what she can produce, what she could produce were she allowed to take her own time about it and were she properly fed. Ill-nourished, almost starved, she tries her best to satisfy and produces at least some fruit, but her offspring are small and lacking in strength. Sometimes she rebels and produces nothing at all for a part of a season and gets back at her task-master, the farmer, in that way, but that seldom happens.

THREE CROPS A YEAR.

You do not need to go outside the Settlement limits of Shanghai to find the soil being cultivated, or mistreated, in a manner that is nothing short of criminal. The Chinese farmer plants two, even three, crops a year on the same plot of ground and it never occurs to him that he is doing anything wrong. He alternates his crops, it is true, wheat is followed by cotton, but as likely as not yellow beans are planted with the cotton, and the crop of weeds and grass which is grown at the same time is taking many times more strength from the earth than the cotton and beans put together. There is a certain time when, the Chinese say, cotton must be planted. The date varies from year to year and is determined by the weather; if the spring is late the planting date is late, as the Chinese say the cotton must be planted when the day temperature is no lower, and will be no lower, than 60 to 70 degrees. In the Shanghai district in the 1916 season, the time was May 10 to 25. If the cotton could be sown a week or two earlier it would be a benefit in strengthening the young plant for its future period of bearing. If planted later it grows quickly but bears too late for all the flowers to mature into fully ripe pods, owing to the approaching cold weather.

FROM ONE GROWTH TO ANOTHER.

The reason why cotton cannot be planted earlier, under Chinese methods, is a simple one. Wheat and other cereals are growing on the same fields which are about to be planted with cotton. If they planted earlier they would lose the wheat, so they plant the cotton as late as they can with safety in order to save as much of the wheat as possible. If there is growing wheat already standing on the ground, how is the cotton to be planted? What is to be done? It would be a foolish question to put to a Chinese farmer for he knows what to do. He simply throws the cotton seeds into the standing wheat. The seeds reach the earth, and with the aid of rain they get into the soil, they sprout, and the young cotton plant, which at this time needs all the help and attention it can get, grows up through the wheat, its roots struggling for food among the wheat roots. It is stunted and weak, but it grows and that seems to satisfy the farmer. The cotton plant is five inches high when wheat cutting time comes.

With five-inch high cotton growing in the wheat, naturally the grain cannot be cut close to the ground. The farmer must be careful not to cut his young cotton, so he cuts the wheat about six inches from the ground. Thus he loses six inches of perfectly good wheat straw, but he thinks nothing of that for has he not gained three weeks' growth of cotton? Cotton partially smothered in growing wheat in this way is not given a fair chance to grow, nor is it after the wheat is harvested, for then the weeds come. The weeds are occasionally hoed off, but as they are left on the ground and are not taken away, they take root again and grow immediately. There are weeds here which if cut to-day and left on the ground will be found to have sprouted new roots to-morrow.

NO TIME FOR PREPARATION.

With the wheat-cotton method of growing it will be seen that the ground has had no preparation for the cotton. It is true, as the Chinese farmer will tell you, that the wheat stubble and roots rot and form excellent fertilizer, but this does not happen immediately. It is some weeks before the decayed stubble becomes fertilizer, and the young cotton plant has not had the nourishment it so much needs during the first weeks of its life, just as a baby needs milk at that time. Wheat straw is burned and the ashes used as fertilizer but such ashes are of soda ash and not the potash and phosphates that the cotton needs. The farmer is not a chemist and knows nothing about this, and there is no one to tell him as there is in other countries where agricultural bureaux are maintained.

If you walk into a patch of cotton in the municipal limits of Shanghai, you will find stunted plants yielding perhaps an average of five small bolls. At the experimental tracts of the Shanghai Cotton Testing House you will find the same stock of plants growing healthily and high and strong, bearing so many as 35 large bolls. The former are grown without selection and with little attention; the latter are grown from selected seeds from selected plants; and the ground, beside being fertilized, has been rested and prepared before planting, and it is kept free of weeds. The difference is marked. Plots of cotton so choked with weeds that the plants are producing almost nothing while the weeds and grass flourish luxuriantly are much too common. "That's very bad," you may tell the Chinese cultivator, and he will agree with you, "The weeds are bad, but I have no time," is all he will say.

A CRIMINAL OFFENCE.

Diseases and traits of cotton are hereditary, as in other plants, and humans. Cotton that is choked and smothered by other crops, whether wheat or beans or weeds, produces seeds that in turn will produce a poor plant. If but one crop, cotton only, were grown on ground that had been prepared and rested, absorbing nitrogen from the air (the soil gets no nitrogen when wheat is growing on it), and the poor plants are cut off and the ground kept free of weeds so that all the strength of the earth can go into the cotton, the crop will be at least three times that grown by the common Chinese method.

The trebled yield of cotton will be worth far more than the stunted yield plus the wheat crop, but it is not easy to make a Chinese farmer believe that, for he thinks he must make the earth work all the time. To smother cotton with a growth of weeds and grass that sometimes is so thick as almost to hide the cotton, should be punishable as a criminal offence, for such methods are slowly but surely lowering the grade of the cotton from one generation to another.

ALTERNATION OF CROPS.

Alternation of crops is one of the first principles of agriculture, and the Chinese certainly plant alternately rice, beans, cereals, and cotton. But they plant the second crop within a few days after the first is harvested, and the third immediately after the second, so that the soil never lies non-productive. Soil is never idle, for when it is not growing a crop it is resting and accumulating strength from the air, but the Chinese farmer never permits this. From November (as soon as the cotton is gathered and the stalks removed) to April the land is growing wheat, barley, and yellow beans. From May (before the wheat is ripe) the same land is planted with cotton, rice, and other beans. Perhaps once in ten years it may happen that the wheat has ripened early enough so that the land may be cleared and allowed to rest for a few days before the cotton is planted, but usually the cotton is sown into the growing wheat.

Foreign Efforts to Improve Culture.

Unfenced, and lying between two foreign residences within ten minutes walk of the French Park, in Shanghai, are two mow of land devoted to the scientific culture of Chinese cotton. Even with that information, if you went in search of the tract the chances are that you would pass it by, unless you happen to be a cotton expert, a botanist, or a Sherlock Holmes. If you are any one of the three your trained eye will tell you at a glance that here some experimenting agriculturist has been at work, but being neither of these but just an ordinary pedestrian, you would not give a second glance at the field which, from the road, looks like any ordinary bit of cotton patch.

There is nothing pretentious about the tract. There is no sign telling you that it is one of the two experimental "farms" of the Cotton Testing House. The other "farm," of three mow, is in Ward Road, and in these five mow of land, measuring altogether five-sixths of an acre, some very important pioneer work is being done, which, were it taken up by the Government on an extensive scale, would result in China producing at least three times her present cotton crop without increasing the acreage. If you were to wander into either of the tracts alone you would not stay long for you would not understand, but if you were guided by Mr. E. Widler, the cotton expert of the Cotton Testing House, you could spend an interesting hour at either tract, even if you did not know the cotton plant from beans.

DIFFERENT METHODS.

The tract in the French Concession is laid out in 32 small beds arranged in sections of four beds each. Cotton seeds from various local districts were planted about a week apart, eight plantings between April 3 and June 10. One bed in each group of four was planted on the same date but with different seeds, so, by watching the growth and comparing, it may be determined which particular seed is best suited to that particular soil. Each of the four beds of the eight sections were fertilized, not with expensive prepared fertilizer, but with ordinary bean cake such as is easily procurable by Chinese farmers. The first bed of each section had 5 pounds of fertilizer, the second 10 pounds, the third 15 pounds, and the fourth 20 pounds, and from this is determined the proper amount of fertilizer. You do not need to have it pointed out to you, for example, that the No. 1 bed of each section has not produced the same growth of plant as No. 2 or No. 3, and you can see that the plants in No. 4 have grown altogether too big. Five pounds of bean cake was not enough to give the required strength to the plant; 20 pounds made the plants grow too luxuriantly, to produce too many branches and leaves, and comparatively little fruit. So the experimenters have determined that 200 to 250 pounds per mow is the amount of bean cake to use to get the best results.

The Chinese date for planting, in 1916, was May 10 to May 25. Here, in September, are plants that were sown early in April and it is proved that that date is not too early, as earlier planting makes a stronger plant. April 27 to May 15 would be the best time for planting if the Chinese farmer had his land free so early. Late planting produces as strong a plant but it is not so productive. The Chinese farmer has to sow his seeds in growing grain, while the experimenters sowed land that had been lying idle all winter and which had been fertilized some time before the seeds were planted. Besides, the land had been ditched and well drained (which the Chinese do not commonly do), for cotton thrives best on dry soil while young but after it has acquired the strength of middle age it needs water to aid it in maturing its fruit. From the tract in the French Concession seeds were produced that will be planted next year either there or at the Ward Road tract. The seeds are selected seeds from selected plants and by following out this scheme of selection the plant is improved from year to year, so that the same plant which, under Chinese cultivation methods produced but five bolls, is made to produce so many as 35.

THE IDEAL PLANT.

An ideal cotton plant is one with a single straight stem from which project other short stems, too short and small to be called branches. The ideal plant has pods on each small stem, beginning at the very bottom close to the ground. The wide-spreading and many-branched plants, which predominate in all Chinese cotton fields, produce far fewer pods with almost none at the bottom and with an abundance of flowers at the top which come so late that they never mature. The plant that runs to branches and leaves uses up its own vitality in producing them and is lacking in strength to produce its fruit.

Now, the plant that runs to branches and leaves and not to fruit will produce seeds that will produce a like plant. So the thing to do, if you aim to improve the plant and its yield, is to cut out when young all the plants that are not "ideal" plants; do not let your scraggly plants produce seeds. The result will be that your seeds for planting next year will be the germs of ideal plants only, and those plants may produce instead of five bolls, say 15, and the plant raised from the seeds of the 15-boll plant will produce 35, or perhaps even 40 bolls the following year. The one-stem plant with its small fruit-carrying stems produces a better, stronger, and finer staple. The plant with the several branches flowering on the top instead of the bottom may be suitable farther south where the summer is longer.

LUCK AT THE THIRD TRY.

Last season (1916) was the third year of experimental cultivation by the Cotton Testing House. The first year was wasted, in a way, experimenting with American seed, but enough was learned from that to show that experiments should be conducted along the lines of improving the cotton already grown here rather than trying to acclimatize imported seeds. The big typhoon of the end of July 1915 interfered a great deal with the work of the second year, yet very satisfactory results were obtained. For example, the "farms" produced in 1916 plants carrying from 10 to 35 and 40 well matured bolls, the average being 20. These plants are from seeds of ordinary Chinese cotton which under Chinese care produced from 0 to 15 bolls per plant, with an average per plant so low as 5. The only difference is that the plant which now averages 20 bolls (and the seeds from which next year should average 35) is grown from selected seeds from selected plants, and the sowing was done in land that had been prepared for it,—and all weeds and other crops were eliminated.

To bring about these results meant a great deal of hard work on the part of those who have had it in charge, but they will be rewarded with even better results next season when they will plant from last year's selected seeds. Besides, they have the satisfaction of knowing that they were doing pioneer work, work which will already have been done when the Government starts its seed producing and distribution bureaus, if that time ever comes. The sort of work done by the Cotton Testing House is really Government work, at least it is so considered in all other countries.

AS IN THE "SUNNY SOUTH."

American residents of Shanghai whose homes are in the cotton belt of the "sunny South," and who have not perhaps for years seen an American cotton plant in full bloom and with full formed but as yet unopened bolls, could have given themselves a treat had they motored down Ward Road in September. The cotton was close to the road, and the patch was a very small one, but if they drove slowly they could not have missed it unless they had forgotten what Home cotton looks like. There were several kinds, "Dixie," "Lone Star," "Columbia," "Holborn," "Sea Island" and such. The Columbia plants were nearest to the road. They were first planted on April 8; the summer here is too short for American cotton so the experts thought they could deceive the plant by sowing a month early. The seeds came up beautifully, grew rapidly for a fortnight—and then they died. Planted again on May 3, they had grown into real Homelike cotton by September. Another American strain, the Holborn, farther back in the field behind the Egyptian cotton, was doing still better, and were laden with bolls as large as apples. The Egyptian cotton is interesting more as a curiosity than anything else. It stood over six feet and with stalks as big around as your thumb, actually shade-giving trees as large as coffee trees and with big leaves shaped unlike other cotton leaves. They flowered but produced nothing, and Egyptians will not be experimented with further.

A WORM I' THE BUD.

There is a great deal in the subject of cotton growing besides the mere growing of it. The worms and bugs, for instance. There is a little pink worm that comes out of the seed before the boll opens. The worm comes from an egg that is laid in the heart of the boll by a fly or a beetle. The insect pierces the boll and deposits an egg inside of a seed. The egg hatches and out comes a worm. Of course it eats the seed in which it was born and then eats its way out through the cotton. In doing so it stains the cotton a pink-yellow colour, and if it were not for the fact that the cotton rots it might be possible to cultivate the worm so as to produce a cotton already dyed pink. But that would involve finding a market for pink cotton, so it is hardly feasible. A large part of the cotton in the Shanghai district in 1915 was effected by the pink worm, and such cotton is saleable only as seconds or thirds for wadding, etc.

But there is a cotton which grows in a certain part of China, and of which there are a few plants being experimented with, which actually grows a brownish colour naturally, a cotton that might be spun into khaki cloth without dyeing, and there may be a future in that.

The Farmer's Neglect of Weeds.

Catch a Chinese farmer—one who thinks he knows all about cotton growing—and take him into the cotton experimental tract of the Cotton Testing House on Ward Road. There he will see such cotton as he never saw before, but if you watch his face ever so closely you will fail to detect any expression of surprise.

He, in his own way, has been growing cotton plants many of which produce no cotton at all, some producing two, four, or eight pods, and a few bearing so many as 15, his average being five bolls to a plant. Show him whole rows of straight single-stemmed plants bearing 15 to 40 bolls each and with an average of 20, and he will say "Number one," and that's about the only comment he will make. Ask him to see how many weeds he can find and, seeing none, he may remark, "That is good; weeds are bad."

EYES THAT DO NOT SEE.

It never occurs to the farmer that he, too, could grow 35-boll plants, as he no doubt looks upon the foreigner's garden-tract as a sort of freak, something far beyond his capabilities. That this is so you may prove to your own satisfaction in cotton-growing time simply by using your eyes. The three-mow experimental tract on Ward Road is in an open field next to the road; immediately adjoining is a Chinese farmer's bit of cotton land, and his rows of cotton are as close to those of the Testing House's expert as if they were of the same ownership. His first two or three rows are comparatively free of weeds—the infection has gone that far—and he will pick more cotton from those three rows than from the next six, for the rest of his patch is more or less neglected and considerably overgrown with weeds. Here is a cultivator who has worked alongside the model tract, slept in the same bed with it, so to speak, and he has learned nothing. He has "had no time" to weed his land; he has let his cotton take care of itself. He looked at what was done by the foreigner, but he did not see that the foreigner was doing no more than he could have done himself.

PASTURE LAND ONLY.

On the same side of the road about a hundred yards away was, in September, a mow of land that would make good pastureage for a pony. A crop of wheat was raised on it in the spring and in the grain were planted cotton seeds in the usual Chinese way. The grain was harvested, but the cotton did not grow—it was smothered by the wheat. This is an example of Mother Earth rebelling, and the farmer who planted the cotton suffered a total out-of-pocket loss. Not far away on the other side of the road is a piece of land at which you will have to look twice before you discover the cotton, so dense and high is the rank growth of weeds, and this is an example of criminal cultivation, for the cotton so grown is inferior and the seeds from it in turn will produce still more inferior cotton.

Had either of the two farmers mentioned in the preceding paragraph allowed his land to lie fallow for a few months, had he turned the soil over and fertilized it some weeks before planting time, had he planted a fortnight earlier than his neighbours, and had he kept the land free of other growths, he would have had a first class crop. Had he gone further and cut off all his non-flowering plants and most of the wide-spreading ones, and allowed only the fruit of ideal plants to go to seed, he would have seed which, next year, would grow a record crop if properly cared for.

EXPERIMENT TOO EXPENSIVE.

"But what a waste it is for good land to lie fallow!" the farmer might think, and naturally so, for why should anyone with land allow it to rest idly when it could be growing wheat or other cereals? There is no one to tell the farmer otherwise, and he cannot afford to experiment by himself for he is sure of at least some wheat and some cotton. On the other hand if he lets his land rest and plants no wheat he will get no wheat, that is sure; and who will guarantee that by sowing cotton on prepared fallow land he will raise so much extra cotton as more than to make up for the grain he didn't plant?

If China had a Government agricultural bureau with district experimental farms it would be part of its duty to show ignorant farmers how to increase yields by allowing the soil to gain strength by resting. But so far as cotton is concerned, its main work would be to grow selected seeds guaranteed to produce good fruit-yielding plant strains, and to see that the seeds were distributed and intelligently used as in other countries. Were that done China's cotton crop might easily be trebled without increasing the acreage, and not only would the yield be increased but the quality would be improved.

A CHANCE FOR CHINESE STUDENTS.

Of the 45 male indemnity students who sailed for America on the str. *China* in September, five are to take courses in agriculture. It is probable that two of the five may learn something about cotton cultivation in America, the world's greatest cotton-producing country. In the list of colleges to which the various students are accredited occur the names of but two agricultural colleges recognizable as such—Massachusetts Agricultural College and Oregon State Agricultural College, one student going to each. Neither of those two students will learn anything about cotton for Massachusetts and Oregon are over 1,000 miles from the cotton belt. However, two students are assigned to the Louisiana State University, which in all probability has an agricultural course, and as Louisiana is a great cotton-producing state it may be taken for granted that these two young men will return to China with some good cotton knowledge. If they are not intending to take agricultural courses, some of their friends here might do them a service by writing to tell them how badly China needs men with a technical and practical knowledge of cotton growing.

There are some Chinese who have studied cotton in America, men who are doing well here, but there is room in China, which some day may lead the world as a cotton grower, for scores of "cotton men," experts. Students now taking agricultural courses in American colleges will be ripe to step into responsible posts when a far-seeing Minister of Agricultural establishes experimental farms in China.

Lines for Government Help.

Owing to the great growth of the cotton spinning and weaving industry in Shanghai during the past ten or twelve years, and the consequent increase in the demand for raw cotton, the acreage under cotton cultivation in China has increased considerably in that time; some authorities even estimate that it has doubled. And yet nothing has been done to improve the quality of the staple or to obtain correct statistics relative to China's cotton industry; as already mentioned, statistics are entirely lacking.

Frequent reference was made to the need for Government action if the cotton industry of China is to continue its rapid growth. The manufacturing industry is sure to become of more and more importance as time goes on, and as the mills increase so will the demand for raw cotton increase, but for cotton of a better quality than that now grown in China. There is no reason why the fineness of the China staple should not be improved to a considerable extent, although it is admitted that for certain purposes the local mills may always have to import American cotton.

SOME DEFINITE RESULTS.

The experiments so far conducted by the Cotton Testing House have demonstrated that not only can the yield per acre be greatly increased, but also that the quality of the cotton may be much improved through modern scientific methods of cultivation. But the work done by the Testing House has been but as a few steps taken into the great field of experimental cultivation. With the gates of the field opened and the path marked out, now is the time for a progressive Minister of Agriculture to step in and lead the way to further exploration. A former Minister evidently looked into the question of the establishment of cotton experimental farms, for it is known that the Department of Agriculture at Washington some time ago received an inquiry from China relative to the employment of an American cotton expert.

SERIES OF OFFICIAL FARMS.

By using the services of trained cotton experts, and by the wise expenditure of money, the Chinese Government could greatly improve the quality and quantity of Chinese cotton, thereby enriching the country and the people and benefiting greatly the cotton industry as a whole. This could be done by the establishment of Government experimental farms in the various cotton-growing districts of China. By experimental culture and the adoption of plant selection and seed selection, by experimenting with fertilizers, it could be determined which particular plant is best suited to a particular locality, all of which has been described. Although it may be too much to expect that the Government would do so from the very beginning, to do the work thoroughly would mean the opening of experimental farms, each of about 10 acres (60 mow) at 10 or 12 centres, but if a start were made with half that number much good work could be done. It is suggested that such experimental stations would be most needed at the following places :—Shanghai 2, Kuangyung 1, Soochow 1, Tientsin 2, Tungchow 1, Shantung 2, Ningpo 1, Shansi 2.

The farms should all be linked together under one system with one head in control, a foreign chief cotton expert who would have full charge of a cotton culture department of the Department of Agriculture. The chief expert would require several trained assistants who, until China can produce her own trained men, must necessarily be foreigners. These assistants could gradually be replaced as students especially trained for the purpose would graduate from American agricultural colleges in the southern states of America where cotton culture is taught. The chief work of the experimental farms would be the production of guaranteed seeds and the distribution of them. They would teach farmers the importance of allowing their land to lie fallow so that the cotton may be planted on land that has been rested, prepared, and fertilized. The farmers would be taught how to recognize and eliminate the non-producing plants when very young, and they would be shown the importance of weeding and keeping the fields clear of all growing things other than cotton.

TEACHING BY EXAMPLE.

It might be necessary at first to prove by actual demonstration that a trebled crop of cotton can be grown by adopting the methods already described. The farmers in the immediate vicinity of the 10-acre model farms would soon see what was being done on those farms and do likewise; other farmers not so near would fall into line, and so the new method of culture would spread. A great deal could be accomplished by offering prizes to farmers who bring to the experimental station of their district plants bearing the greatest number of cotton bolls, and further prizes might be offered to those who produce the best specimens of ideal plants. This would create interest and cause rivalry among neighbouring farmers, all of whom would take pride in their product.

It is often necessary in China to look to the Japanese for examples of progressiveness. It was only a few years ago, comparatively, that the Japanese acquired the South Manchurian Railway which traverses upward of 600 miles through the eastern provinces. With the object of increasing the productiveness of the country so that the railway might increase its earnings from freight-carrying, the railway company has for some years found it profitable to conduct several agricultural experimental farms in various parts of Manchuria where grain, fruit and vegetables are cultivated scientifically and the seeds distributed. If a railway company operating in China (or if you prefer, the Japanese Government operating through the railway), finds it advantageous to maintain experimental farms, there is no reason why the Chinese Government should not do likewise in China proper, and especially when it is considered that by establishing cotton culture stations she would be fostering an industry which bids fair to rank as the country's leading agricultural asset in the near future.

EGYPT'S THOROUGHNESS.

Every other cotton-growing country in the world has its experimental farms, and China to-day stands alone as the one country that does nothing toward bettering the quality or increasing the yield of its cotton. Reference has already been made to what has been done in South Africa which now grows a high quality of staple which commands a high price. In Egypt, the cotton industry is closely watched by the Government, which conducts a most effective agricultural bureau, and India, thanks to what has been done by the Government there, may before long be producing half as much cotton as America.

As an example of the thoroughness of the work done by Government experts, it may be mentioned that the bureau in Egypt is growing some cotton in bee-proof houses. As everyone knows, bees go from flower to flower in their quest for honey and so carry pollen from one blossom to another. In this way a pure strain of plant may be impregnated by bees with pollen from an inferior plant, with the result that the pure strain is no longer pure but bears an inferior fruit. Consequently at great expense the agricultural bureau in Egypt has erected bee-proof houses in which a particular kind of cotton is grown for its seeds with the assurance that they cannot possibly be contaminated. Bees may cause a noticeable change in two or three seasons. For example, while the prevailing colour of the cotton flower in the vicinity of Shanghai is yellow, there is a kind grown here which flowers white. Plant the two sorts in adjacent fields and in a few generations you will see yellow flowers on the white-flower plant and *vice versa*, and even both colours on the same plant. Seeds from such plants will produce a hybrid crop.

SOME SIGNIFICANT FIGURES.

To study such things, to discover the most suitable cotton plant for a certain district and to adopt means to keep that strain pure—would come within the province of China's Agricultural Department. There is other work, too, for the Agricultural Department—as to that, there will be time enough when the Department is established. These figures, however, might be of interest:

China's yield of lint and seed per acre runs from 180 to 250-lb.; that of the United States is 400 to 600-lb.

Of lint proportion to seed per boll, China yields 25 per cent. while America produces 40 per cent. The Testing House farm has produced 39 per cent.

The Department could discover how China's yield may be put on a par with that of America.

Ideas at the Ministry of Agriculture.

In the preceding chapter it was stated that it was known that some time ago the Department of Agriculture at Washington received inquiries from China relative to the employment of a cotton expert. After that was written it was learned that the matter had gone even farther than that, for not only did Mr. Chow, the former Minister of Agriculture, make inquiries in America but he actually engaged a cotton specialist in the person of Mr. H. H. Jobson, of Texas. Mr. Jobson arrived in Shanghai in the Spring of 1916 and spent a few days in Shanghai on his way to Peking. This information comes from Mr. H. Y. Moh, mill manager of the Teh-dah Cotton Spinning Co., who is himself a foreign-trained cotton expert and who entertained Mr. Jobson while he was in Shanghai.

Mr. Moh, at the time of writing, was in correspondence with the present Minister of Agriculture, Mr. Ku Chung-hsiu, who recently asked Mr. Moh to supply certain statistics relative to Chinese cotton, crop, yield, quality, count of yarn that can be spun from it, etc.

A FARM IN VIEW.

So far as Mr. Moh was then aware, no definite plans had been formulated in respect of Mr. Jobson's work except that it is settled that he is to start an experimental cotton culture farm. Apparently the location is not yet decided, for it was first reported that the farm would be established in Honan, which is altogether too far north, and later reports had it that it will be at Changsha in Hunan, which is hardly a desirable location for the initial farm. If Mr. Moh's advice were accepted by the Ministry of Agriculture the farm would be at Hankow, Mr. Moh preferring that district as most central.

China should certainly establish a chain of cotton experimental stations, said Mr. Moh, adding that the matter is of pressing importance. He has no doubt that it is the Government's intention to start such farms, but whether the intention will be carried into effect he is not so sure. Anyway, the expert is here and that means a great deal. Mr. Moh has his own ideas relative to what should be done, and agrees with the suggestion that there should be at least 10 farms.

THE MEN READY TO HAND.

As for the personnel, Mr. Moh thinks that Mr. Jobson should be able to get along very well with the material already at hand in China. There are numbers of returned students who have graduated at agricultural colleges in America, Mr. Moh says, men who had themselves been educated in America with the intention of taking up positions in the Department of Agriculture. On returning to China these men found no Government posts awaiting them and most of them may be found now engaged in teaching English.

It is Mr. Moh's idea that ten of these men should be selected to work for a year or two with Mr. Jobson so soon as the first farm is started. Even though they may not be familiar with cotton, having graduated from agricultural colleges, they should fit in very nicely under the direction of an experienced man like Mr. Jobson, and after their training under him they could be utilized in the establishment of other farms under Mr. Jobson's supervision as director. Now that the expert is here, China has taken the first step, and whether the desired end will be attained depends much on the authority given him. If he is given a free hand it is safe to state that some worthwhile things will be done; but if he is handicapped, as foreign employees of the Government usually are, with no real authority of his own, the outcome is entirely problematical. As Mr. Moh says: "The work should be done; whether it will be done is another thing."

GENERATIONS OF COTTON.

And in Mr. Moh himself there is a story. He comes from a family of Shanghai cotton merchants, his family having dealt in cotton for several generations. He was raised in a bed of cotton in an atmosphere in which cotton lint floated; and naturally he followed in the footsteps of his ancestors. But he determined to learn something more about cotton than the mere buying and selling of it.

He had had no foreign schooling, his education having been received from Chinese tutors, under one of whom he studied English for a year or two. In 1909, when he was 33 years old, he went to America and spent two years at the agricultural college of the University of Wisconsin at Madison. This was followed by two years at the Illinois University at Urbana, from which he graduated with the degree of B. Sc. But, having gone to America with the idea of learning all there was to learn of cotton cultivation he was not satisfied with having attended two great universities, so he went to Texas and took a post-graduate course at the Texas Agricultural and Mechanical College.

THE STARTING OF THE MILL.

At the Texas institution Mr. Moh got the actual experience he desired. He spent some months in the cotton fields near the college doing actual field work and learning the growing end of the cotton industry from A to Z. There he also got practical mill experience; for the college maintains a model mill of its own in which the students are the workmen.

When he returned to Shanghai in 1914 and it became known among his father's friends, cotton merchants, the sort of knowledge he had brought from America, some one said " Why not organize a company, start a mill of our own, with Moh as manager? " This they did with a capital of Tls. 500,000 in 5,000 shares. The mill was opened at 78 Ward Road in June, 1915, and at the end of 1916 was operating 17,000 spindles with 3,000 more on order. The mill is spinning yarn of 14, 16, 20, 24, 26, 32, and 42 counts, using, of course, American cotton for all finer than 20.

Beside Mr. Moh there are at least two other men who have studied cotton in America. One is Dr. Hung Ching-kuei, now believed to be with the Department of Agriculture at Peking; the other is a wealthy dealer in vegetable oils. Mention should also be made of the important experimental work so admirably carried on at the model farm and experiment station of Mr. Chang Ch'ien, former Minister of Agriculture, at Tungchow.

RESULTS FROM AMERICAN SEED.

About a mile north of Mr. Moh's Ward Road mill he has a tract of ten acres where he has been experimenting with American and other cotton for two years, 1916 being the second season. He believes that Mr. Widler, of the Cotton Testing House, is mistaken when he says that American cotton cannot successfully be grown here because of the short summer. In 1915, in spite of the typhoon, he grew 20 catty of American cotton and from the seeds so obtained, he planted American cotton again last season.

He had about 30 varieties of American cotton to which three acres were devoted and nearly all did well. He planted his seeds the first week in April and they produced flourishing plants, while the Testing House's American seeds planted at the same time proved a failure. By planting last season's seeds next year, and continuing the process, Mr. Moh believes he can demonstrate that American cotton can be acclimatized to this district, so as to mature before the coming of cold weather. He also thinks it will not run back to the native plant if it has proper attention, although time only can prove that opinion. The Shanghai district is no colder than Georgia, one of America's great cotton states, and Mr. Moh at present sees no reason why American cotton cannot be made to produce here. The whole secret, he says, is to plant the seeds far apart as the American plant needs plenty of room.

The probabilities are, however, that not much dependance can be placed on American seed, and that if China's cotton is to be improved in quality and yield that improvement will be reached through scientific cultivation of the native cotton already growing in the various districts.

II.

THE MANUFACTURE OF COTTON.

From the Fields to the Mills.

The most wonderful of the world's useful plants is the cotton plant. From the sowing of the seed to the flowering of the plant and the final maturing and opening of the bolls of fleecy fibre, is marked in time by a few months only. The seeds are sown in early May, the plants have flowered by August, and 45 days after the flowers appear the plant has yielded its valuable fruit. September and October are the chief cotton-picking months, and look where you will at that time in Shanghai's roads, on the creeks, or on the Huangpu, and you will see cotton on its way to market on bamboos, wheelbarrows, carts, and boats. What happens to the cotton from the time it is picked in the fields to the time when it is offered to you over the shop counter as manufactured cotton cloth?

A BUSY TIME.

The picking of cotton in the Shanghai district begins in August and continues to the end of October, and picking time is a busy time. Individually, by reason of the fact that the Chinese farmer is a very small one with but a few mow of land for which he pays rent based on a percentage of the value of the crop he raises, the picking of cotton is not such a serious matter here as it is in America, where a single farmer may own hundreds of acres and must employ hundreds of blackies for the picking. The more highly cultivated plant of America is often so trained that all the pods on the plants of an entire estate may open within a period of 10 days so that gangs of pickers may clean up practically the whole estate in a comparatively short time.

Here it is different, and it always will be unless it would be possible for a foreign company to rent or acquire large tracts of land for cultivation on an extensive scale. When the average farmer has only 10 mow, or say an acre and a half at the most, it is a case of his family doing the picking, or if the farmer needs outside help he employs the children of his neighbours. The picking costs about five cash per catty of seed cotton and the children (most of the cotton-picking labour is juvenile) go through the patch again and again, picking such bolls as have opened. The average yield per mow is 1½ piculs if the land has been used only for cotton growing and with proper fertilizing, but when cereals are grown in rotation the average yield per mow is only 85 catties.

After the opened pods have been picked there is still much work to do before the cotton is ready for the mills. At the best only about 35 per cent. of the weight of seed cotton is lint; the rest is seed. To separate the seeds from the lint means that the cotton must be ginned for which it must be as dry as possible. Consequently, as cotton is naturally absorbent, it must be picked when dry and it must be kept dry. Whoever has seen a cotton field by moonlight or has taken a walk at sunrise in a field snowy with open cotton, knows how the glistening dew drops stand on the opened pods. An hour or two of sun absorbs the dew, and the cotton may be safely picked. Still it may be moist from rains or natural absorption, so it is necessary to expose the picked cotton for two or three days that it may be thoroughly dried in the sun. This is done in trays that are taken in, or covered, at night. When dry the cotton is ready for the gin.

THE OLDEST WAY THE BEST.

Ginning is really the first process of cotton manufacture. The lint clings tightly to the seeds which are bedded in it and the two must be separated with great care, first to avoid breaking the fibre which is already too short in Chinese cotton, and, secondly, to avoid breaking the seeds which are required for planting next year's crop, 60 to 70 pounds of seed being required per acre. In about one house in every six in the cotton-growing district there is a home gin. This is a simple affair of wood and iron, mostly wood, driven by man power and crude in the extreme.

Yet this primitive gin, which found its way from India probably centuries ago, does far better work than the most approved steam power gin. It is a sort of small "horse" with a pedal. By working the pedal up and down with his foot, the operator causes a small spirally grooved roller to revolve horizontally by means of a cord passed around it, in the same way that the Chinese carpenter causes his brace to revolve by drawing across it a sort of bow to which a cord is attached. The roller turns above another roller that is stationary, and between the two the seed cotton is fed, a pod or two at a time. This process removes the seeds without crushing or breaking and without harming the fibre. The farmer can gin 20 catties clean cotton in 10 hours at a cost of 100 cash for labour. The work is slow but it is sure, and the local mills prefer to purchase cotton that has been ginned in this primitive way as it is the cleanest-ginned cotton in the world.

The steam gin works on an entirely different principle. It does its work quickly, but not only does it tear the fibre, it splits and crushes the seeds the broken parts of which are left adhering to the lint. The power gin in common use is of Japanese make, and the trouble is that it is run without proper adjustment. As a roller forces the cotton between comb-like teeth, the seeds are forced and pulled out of the clinging lint with the result that the filament is broken and left with parts of seeds still clinging which gives much trouble in the mills. The market quotation for steam ginned cotton is in consequence slightly under that ginned in the common way.

Before ginning, the farmer selects the best cotton which he never sends to market at all. He keeps it at home, or at least in his home village, and there on his home spinning wheel and his hand loom, he spins it and weaves it into cloth. For this purpose, and for bedding and wadding clothes, 1,000,000 or more piculs are used in China annually. Consequently the mills and the steam ginneries do not find it altogether easy to get really first-class cotton. There are several large steam ginneries here in Shanghai and at other centres; but they are not profitable and the probabilities are that so long as cultivation is on such a small scale they will not be profitable. Some years ago some of the local mills installed power ginning plants so as to be able to buy seed cotton and gin it themselves, but the plants are now idle as the mills prefer to buy the home-ginned staple.

WATERED COTTON.

Much is heard about watered cotton. It is sold by weight and it is absorbent, and it seems as natural for some dealers to water their cotton as it is for the milkman to water his milk. Mill owners for years have been complaining of an over amount of moisture in the cotton that comes to them. Some of the water is put in deliberately to increase weight and much gets in by reason of careless handling. The absorbent fibre is put into loose bags and transported from place to place in barrow, cart, or boat, uncovered and exposed to dew and rain.

It is as dry as possible when it leaves the farmer, but the various dealers and handlers take little care to exclude moisture as the damper it gets the heavier it is. Boatmen, who may be in need of cotton for their bedding, think nothing of extracting a few pounds from the different bags in their cargo and throwing in enough water to make up for the weight abstracted. If exposure to weather has not added sufficient moisture, dealers will instruct their coolies to squirt water into the bags, using their mouths as sprayers, as the laundryman sprinkles his clothes when the sanitary inspectors are not around.

Exhaustive experiments conducted in 1914 by the Cotton Testing House, which was organized for the purpose of combating cotton adulteration, show that the natural moisture held by local cotton, of which the best care has been taken, is 11 per cent. In Tientsin, where a more recently established Testing House is doing excellent work, the average is 10½ per cent. But there is very little cotton offered for sale with so low a percentage of moisture, the usual being 15 per cent. which is the maximum allowed. If there is more than 15 per cent. moisture the mills refuse to accept it. The Chinese may always deceive themselves by adulterating cotton in this way, at least to some extent, forgetting that wet cotton means yellowish cotton of consequent less value, but owing to the work of the Cotton Testing Houses during recent years the practice is less serious. Press-packed cotton which comes from interior provinces is comparatively dry as it cannot be tampered with, but when cotton is to be transported only a comparatively short distance, it is not considered by the dealers necessary to press-pack it and so it is easily adulterated.

So the cotton reaches the mill.

Raw Material to Finished Yarn.

A pound of ginned cotton drawn out to 20's yarn (20 times 840 yards), such as can be made easily at any Shanghai mill, would be 16,800 yards long. That is 9½ miles, or approximately five round trips between the Palace Hotel and the Palace Hotel Annexe in Shanghai. An American bale of 500-lb. would produce a length of 20's yarn that would stretch 4,750 miles, or from Yokohama to San Francisco, and 20's is not a particularly fine yarn. A pound of 60's would be 28¾ miles long, and a bale of 60's would extend 14,375 miles, or more than half-way around the earth. Lancashire mills are producing 300's; that means a pound of cotton drawn out to 143¼ miles, and 500-lb. of which would encircle the globe three times. How is it done?

The question is best answered by making extracts from a lecture delivered a few years ago before the Shanghai Society of Engineers and Architects, by Mr. James Kerfoot, M.I.M.E., superintending manager of several of the largest mills in Shanghai :—

WORRYING AND CLEANING.

"If the cotton is received at the mill ginned and in the press-packed bales, after these have been unhooped, half a bale, or say 200 lb., will be dumped into a hopper bale breaker, which takes the place of hand labour in pulling the cotton into small pieces, and feeding the same to a lattice which, if it is very dirty, consigns it to a Crighton opener. This machine has a vertical conical beater with a series of arms or blades secured to the shaft. Conical dirt grids surround the beater, these grids are made with raised surfaces against the face of which the cotton strikes, and having openings in them the dirt can be easily ejected. A fan draws the cotton away from the beater, and if a combined machine, carries it to revolving cages which pass it forward to calender rollers where it is made into a certain width and thickness and rolled into a 'lap.'"

"Four of these laps are taken to a 'scutcher,' which is a further process of cleansing by blowing and beating. At this stage a process of calculation and adjustment commences of which it is desirable to take note. Threads of spun yarn differ in kind and degree, and apart from the broad distinctions of warp and weft, are coarse and fine according to the purpose for which they are intended. These differences are estimated in 'counts' ; cotton yarn, if wound into hanks from the cop, contains 840 yards in each hank, the measurement being invariable the count means the number of these hanks to a pound of yarn. If 60 are being spun, there will be 60 hanks at 840 yards each in a pound of completed yarn ; from the early scutching operation to the ultimate winding of yarn upon the spindle, it is necessary to adjust the delivery of material to the machines, and the manner of dealing with it there so that the thread shall come out at last in proportion to the count."

FROM THE LAP TO THE SLIVER.

"The cotton emerges from the scutcher in the form of felted web, like a thick sheet of wadding, and is rolled on to a small roller and is called a 'lap.' This has to be tested to see that in weight it agrees with the count to be spun. Then this lap is passed on to the 'carding engine,' which disentangles the fibres and forms them into a sliver. The lap disappears slowly into the machine and the cotton undergoes a combing between the cylinders and revolving flats which are covered with fine wire teeth, some tearing it one way and some another as it passed between them, so that when it escapes from their opposing forces it is not only much cleaner than when it went in, but has its fibres so combed out as to present a filmy gossamer-like appearance, which disappears to some extent as the fibres converge and form a ribbon-like sliver which is deposited and coiled up in a can.

"To get the count a certain length of sliver must be resolved from the lap, and to ensure this an arrangement of the speed or draft must be made, so that for a given inch of lap a certain length of sliver will be produced. The sliver is now taken to a 'drawing frame,' and here the finger and thumb of the hand-spinner has to be provided for. The machine has three parts or 'heads'; to the first of these the sliver is taken to be united with five others of its kind, and after they have been passed between rollers running at varying and nicely adjusted speeds, six of these new slivers are then taken to the next head, and the process is repeated.

"A third time a combination of six is made, and a sliver drawn out which has within it 1,216 of the original slivers as they issued from the carding engine. The drawing frame is so sensitively adjusted that if one of the slivers should break the machine stops at once. These latest slivers are then taken to a 'slubbing' frame, and here the spindle first comes in evidence, with a bobbin and flyer attached."

NOW, THE SPINDLE.

"The order of procedure is to pass each sliver through drawing rollers for purposes of due attenuation, and then, with a slight twist in the process, and a finger-like movement of adjustment, wind it upon a bobbin by means of the revolving spindle and flyer. The slightly twisted slivers are then taken to an 'intermediate' frame, where the contents of two of these bobbins are joined into one, under similar treatment of spindle and flyer, but with finer and more rounded results. Then comes the 'roving' frame, where once again, by means of spindle and flyer, the preparation resolves itself into the complete roving by two bobbins from the intermediate frame having their contents united, and so giving in the doublings 864 of the original carding slivers. As the strands here get finer by increased drawing, the bobbins are proportionately smaller, and the number of them is increased in the frame. The winding on of the roving, too, becomes a matter for nice mechanical adjustment, as differential movements have to be applied to give the cone-shape, and the speed has to be adapted to the increasing or diminishing bulk of the bobbin.

"The rovings are now ready for the spinner and are conveyed to the spinning room where the twisted thread is made either on the 'ring frame' or the 'self-acting mule.' In the earliest order of things one spinster worked one spindle, but now there are 1,500 spindles on the 'mule.' The same condition of things survives as to the 'stretch' in the modern mule, which deals with lengths of 63 or 64 inches, and completes them separately in the processes of drawing, twisting and winding-up. All the operative spinner has to do now is to attach his rovings to the spindles, piece the threads when they break, and clear the spindles of the cops at the required time."

THE WONDERS OF THE MULE.

"A very delicately-intricate piece of machinery is this modern self-acting mule. It is, in its complicated mechanism, the product of an accretion of many inventions. Looked at from an impressionist's point of view, it presents an intricate arrangement of shafts, wheels, rollers, pulleys, levers, ropes, and springs, the most complicated features of which centre in the 'headstock,' from which power is transmitted and controlled. This headstock divides the mule into two parts, and acts upon each simultaneously. As the 1,500 spindles fixed in the frame of the mule are all performing identically the same work, it will be easier to understand the whole by concentrating attention upon the spinning of a single thread.

"The bobbin containing the roving is placed in a creel on the frame-work at the back of the mule. The end of the roving is then passed through a guide wire to be conducted between three pairs of drawing rollers also working on the frame in front of, and a little below, the creel. The back pair of rollers simply take hold of the roving and conduct it to the next pair whose motion is slightly quicker than the others, but only sufficiently so to keep the roving uniformly tense, and to secure an even attenuation when the further drawing is taken up by the front pair, which are revolving at a much higher speed. Here the count of yarn is regulated by the adjustment of speed in these drawing rollers, so as to get the required draught or drawing-out of the rove in due proportion of attenuation."

12,000 REVOLUTIONS PER MINUTE.

"When it has passed from these last rollers the roving is attached to the spindle, which is placed on the frame of a travelling carriage, whose wheels work on a fixed and measured tramway. This carriage moves at a little quicker pace than the last delivery rollers and so has what is called a 'gain,' which consists in such a further drawing of the yarn as will take out any unevenness in its delivery, and give a uniform twist to the whole. The spindle upon the carriage is placed not upright, but at an angle leaning inwards toward the roller. This inclination is made to secure the easy passage of the thread over the spindle point, when the twist is being put in, and to avoid undue strain or slip. The inclination of the spindle is varied according to the count of the yarn; the finer the yarn the greater the inclination. When the roving has been attached to the spindle the carriage is made to move outwards, the spindle running at from 10,000 to 12,000 revolutions per minute, drawing with it the thread, and twisting as it draws until the traverse, say 64 inches, is completed.

"Then simultaneously the carriage, the spindles, and the rollers cease moving, and there is an almost imperceptible pause. Then commences what is called the 'backing-off' movement. This consists in reversing the action of the spindles, and unwinding the several turns of yarn, which lie upon the spindle between the top of the cop and the spindle point. The thread is then guided to the proper position upon the cop, and the winding commences. This operation is performed by 'faller-wires,' which here come in to take the place of the spinner's hand, and so adjust the loose yarn that it can be wound in its proper place. When this has been completed the carriage commences to run in again towards the rollers, which no longer revolve but hold the twisted rove while it is being wound upon the spindle, a second faller wire having come into operation in the meantime to conduct the thread with a finger-like movement, and adjust it upon the cop, which has cone-shaped ends, and, in consequence of this, requires a differential movement by which the tension of winding shall be regulated to the varying form and increasing bulk.

"In the working out of this result it is interesting to note that in the light thread which is extended from roller to spindle-point you see an attenuated combination of 1,728 of the filmy ribbons of cotton which come from the carding machine, and that if the count be 60's, the pound of yarn representing that number will measure 28¾ miles."

"RING FRAME" SPINNING.

"'Ring frame' spinning had its birth in America as far back as about 1832-3 (a date not long after the invention of Robert's self-acting mule) and though introduced into England a year or two later, it seems for one reason or another to have failed to establish itself successfully until some forty years or so afterwards, when it was taken in hand by Mr. Samuel Brooks, a member of the firm now known as Brooks & Doxey, West Gorton, Manchester.

"The ring frame is a continuous spinner, and the main point of difference is in the construction of the spindle, which is more elaborate than any other in use; otherwise, as in all other frames, there is the same delivery of the rove from rollers working at various speeds. Instead of the spindle carrying a flyer as in the throstle, the yarn is conveyed to the bobbin through a metal ring or small cylinder, within which the spindle has full play. On the flanged rein of this ring is a long-prime sans cap-shaped clip, which has a free movement of its own on the ring's fixed circumference. This clip, made of special steel wire, is called a 'traveller' and does the same service for the yarn that the leg of the flyer did in the throstle frame.

"The manner of working is as follows: The attenuated rove from rollers passes through the eye of the guide wire, and so downwards to the ring, and there is passed through the 'traveller' and thence finds its way to a bobbin upon the spindle. As the spindle and bobbin revolve, the rail upon which the ring is fixed, having a traverse movement, rises and falls alternately, and the 'traveller' being dragged round the ring, carries the yarn to the bobbin, there to be built up consistently with the left of the rail, and with certain differential movements necessary to correct and even adjustment.

"During the last 20 years the ring frame has been improved considerably, and is now a keen competitor with the mule for yarns, of coarse and medium counts; owing to its simplicity, cheaper labour can be employed, and for countries such as India, China and Japan it is more adapted to the people than the mule. For fine yarns of superior quality, the mule to-day is incomparable with the ring frame for 60's counts and upwards, and if you consider that yarns of

300's counts, of 143¼ miles to one pound, are being produced, in Lancashire with ease, you will agree that the mule has reached a stage of excellence which one would think could scarcely be improved.

"Weft yarn, or that which is laid transversely in the cloth, leaves the mule or ring frame in the condition in which it is required at the loom, out the 'twist' or warp yarn passes through several 'preparatory' processes to fit it for the operation in the weaving :—

1.—Winding, to take the yarn from the cop or bobbins and place it on the warper's bobbin.

2.—Warping or beaming, to wind the yarn from 400 or 500 bobbins to one large beam.

3.—Sizing, i.e., covering the warp with an adhesive preparation, to fit it for standing the strains in weaving.

4.—Attaching the healds and reeds to the warp, called looming or drawing in.

5.—Weaving."

Expansion of Local Weaving Industry.

A big cotton mill is full of music.

You have more than once stopped pacing the deck long enough to peer in at the open ventilating door of the engine room, you have looked long into the depths below, you have watched the vibrating, pulsing engines —and you have listened. The music you heard you can hear now; loud, yet not loud; a rhythmical, steady volume of harmonious sound with never a discord. The music you hear in a cotton mill, where 50,000 and more spindles and looms are the musicians, is like that which comes up from the depths of the ship's engine room, with a difference. It is of a thousand times more volume, yet it is not jarring, not loud. There is so much force and strength in it that when your guide, who knows, talks to you he speaks directly into your ear; yet he seems to talk naturally, without shouting. When you reply he hears, but your own voice sounds to you like a whisper. It is an uninterrupted, harmonious, pleasing roar made by the whirling of countless wheels mingled with the higher pitch of numberless light pieces of falling and lifting metal, and the spinning of myriads of spindles. Yet, it is not a roar; a tired child would find it a lullaby. It is music.

THE SONG OF THE SPINDLES.

The song sung by the spindles and looms is the song of China awakening from her sleep of centuries, for just as Japan woke so will China, some day, only more so. From the lower part of Yangtszepoo Road, from Jessfield way, from Pootung, in Shanghai, and from other China cities, fingers are pointing toward the day when China will not only supply her own needs but the needs of other nations as well. And one of the greatest of China's needs is cotton cloth with which to clothe her millions. The spinning of cotton yarn has been a growing industry these score of years, in spite of what the Government has done to retard it, but in very recent years an industry entirely new for China has developed—power weaving.

The weaving industry bids fair to grow and grow until China herself will fill the greater part of her needs for cotton manufactures, for Shanghai to-day is already manufacturing a variety of all grades of cotton cloth as good as goods of the same grades made in Lancashire or Massachusetts. The output is small, it is true, very small comparatively, but a start has been made, it has been demonstrated that the country is climatically suitable, and far-seeing ones look to a time within measurable distance when China will cease to be the great market for the mills of Lancashire it has been in the past.

To tell the story of what is done to the finished yarn product before it finally leaves the mill in the form of cotton piece goods packed in bales and cases, would require a whole series of articles beyond the scope of this pamphlet. The working of the looms is an old story, however, as familiar to the readers of fiction as to those who confine their reading to newspapers and technical journals. No attempt is made here to describe either the looms themselves or the work they do, for as soon as the layman finds himself in an immense room containing rows and rows of the busy singing machines attended by silent workers, men, women, and children—rooms so large that the aisles between the close-set machines appear to verge in points in the perspective of the distance—he realizes that only a technical pen, or one of a writer who has spent weeks there, could adequately describe either the scene or the doing of the work. A time-pressed mill superintendent can only afford to hurry a visitor from one department to another: the visitor sees a little of this and a little of that, and comes away a bit confused, so immense is the place and so great the variety of work done.

PIONEERS IN MILL WORK.

The "Jardine" mills, to the management of which is due the credit for much pioneer work, have been doing great things since the beginning of the war and to-day are operating several large loom sheds equipped with the latest and most approved British machinery, machines stamped "1915." Much of the equipment was ordered before the war, and there is much more on order that has not been received owing to delays caused by the war. There are several large concrete-floored rooms standing empty, awaiting arrival of additional machinery. Local Japanese mills are also adding weaving departments and several big Japanese concerns have recently bought land here ready to build when the time is ripe.

There is not a mill in Lancashire where such a variety of goods is made as in the Ewo and Yangtsze mills here. In Lancashire the output of an entire mill will be limited to one sort of goods; here many sorts are made under the one management, practically under the one roof—everything from coarse sail cloth and canvas, to the finer sheetings, drills, jeans, twills, shirtings, and flannelettes, and these may be obtained in the grey, bleached, or dyed states. The counts of yarn regularly spun at these mills are from one hank to 42's. Besides doubled yarns from the ring frames, mule yarns are also made for a variety of uses in the production of blankets, sponge-cloths, matting, fishing nets, etc.

MAKING GERMAN BLANKETS.

A special department started in 1916, which is the thin end of the wedge in the German trade with China, is the making of cotton "German" blankets of different colours such as are used by every coolie and soldier in the north. Prior to the war such blankets have been imported from Germany in large quantities, and this no doubt is but one of the many items of trade which Germany will be unable to recover after the war. German agents here formerly bought cotton waste from the mills and sent it to Germany, there to be made into blankets and returned. But these mills are now utilizing all waste products so that not a pound of unmanufactured cotton leaves the mills. Five hundred blankets a day is the output from one mill, and blanket-making is not yet a year old, at time of writing.

Not content with waste spinning and weaving, the management have also equipped and started a bleachery and dyeing plant and to-day a splendid bleached and dyed cloth is being produced. All this pioneer work has required close application and study, both in machinery and methods, for in some cases special machinery suitable for Chinese labour has had to be got to meet local requirements, but the difficulties have all been overcome, and now the Ewo mills are ready when the time is ripe to enter into those special branches in a much larger way, having a complete knowledge of what is required to cater for Chinese trade.

CLEANSING PROCESSES.

Leaving the weaving department, the cloth has yet to be finished and that requires several processes. For one thing it has to be scoured and bleached, for impurities, accidental or intentional, may amount to 20 to 30 per cent., consisting of grease, starch and other ingredients used in the sizing, besides oil from the machinery. The removal of these impurities so that nothing but pure white vegetable fibre remains is the result of bleaching. Can you imagine anyone washing a piece of white cloth of endless length? The pieces are stitched end to end so as to form a long endless rope which can be worked in continuous length, and this is treated in a vat of hot caustic soda solution. It is then washed and brought into wagon cages, there folded by machinery, and the cages are pushed into the steamer kier, which consists of a horizontal boiler or cylinder one end of which can be entirely closed by an iron door which is lifted and lowered by hydraulic arrangement. There the cloth is treated with caustic soda lye for about five hours, and then washed with hot water. Two cages can go into the steamer kier and two tons of cloth can be treated at a time. The bleaching is effected in a series of troughs in about the following order:—Hot water rinsing, first chemic bath, passage through carbonic acid chamber, washing, scalding with soda ash, washing, second chemic bath, carbonic acid, wash, sour with hydrochloric acid, then well washed and finished.

CLOTH ROPES.

The cloth-rope passes through the machine at the rate of 60 yards per minute and the whole process takes only 10 or 12 hours. As it leaves the last operation the fast-running rope of cloth passes over rollers high in air and is opened out and becomes flat again. And there are the dyeing vats, too, for dyed goods such as would make good summer suits for any man, or nice dresses for any woman are being made in Shanghai mills—goods that are sold in Shanghai shops at far cheaper rates than the imported.

Export and Import Trade in Cotton.

China's importations of cotton from foreign countries are increasing, and these importations will continue to increase as the mills increase, because, as has already been pointed out, the finer yarns cannot be spun from Chinese cotton as it now is; and unless the mills are to confine their output to weight and not length or fineness, they must continue to import American and other cotton for their finer work. From September 1, 1915, to August 31, 1916, Shanghai alone imported from foreign countries 340,809 piculs of raw cotton as compared with 247,122 piculs the previous year. The usual local yarn is 12's to 16's and if the mills wish to spin 20's or finer they must depend on imported cotton, as the local staple is not suitable for anything much finer than 16's.

A pound of cotton, it might be explained in passing, drawn out to 840 yards makes what the mill men call one hank. To produce 14's means that a pound of cotton must be drawn out 14 times 840 yards, and 20's 20 times, etc. Shansi cotton, which is from an American strain introduced into China, is about the only Chinese cotton that can produce a finer yarn than 16's, and at the same time obtain a satisfactory production; and what China needs is more cotton of that type, or finer.

When you pay Mex. $1.50 a pound for a packet of medicated cotton which your chemist imports from America, the probabilities are that that same cotton originated in China and when it was exported it was valued at about 20 cents. There is a special grade of cotton peculiar to Shantung in much demand in America, where it is prepared as medicated cotton, for which it is especially adapted as it is so white that it requires no bleaching. It is a short fibre and harsh to the touch, so it makes an admirable imitation wool either when used alone or mixed with wool in the manufacture of cheap hosiery and underwear.

SHANGHAI EXPORTS.

Following are the export figures for Shanghai for the year September, 1915, to August, 1916, compared with the same period ended August, 1914. The quantities are piculs:

	1913-14.	1915-16. *
Antwerp	2,584	—
Bremen	9,634	—
Genoa	5,155	—
Hamburg	51,353	—
Havre	3,082	—
Hongkong	29,519	3,361
Japan	404,810	283,935
Liverpool	7,881	26,046
London	1,184	1,790
Marseilles	7,635	648
Dunkirk	661	—
Boston	49,102	47,424
New York	31,902	38,055
China Ports	82,858	102,580
Sundries	29,736	20,660
Total piculs	717,096	524,499

*1915 was a short crop owing to typhoon.

It will be noticed that the exportations to Liverpool have considerably increased, as has been the case for several years. Liverpool's importations from Shanghai having been but 3,157 piculs for the year ended August, 1913. This may be accounted for by the fact that there have been no exportations to various war-affected ports and that the manufacturers in England are beginning to make the cheaper grades of goods formerly made by Germany. If it is the intention of British manufacturers after the war to manufacture the sort of goods that had been made in Germany before the war, they will require larger quantities of the sort of cotton that China can supply. The local mills, as already told, are now manufacturing certain goods that were formerly imported into China in large quantities from Germany, as are the mills in Japan. The foregoing figures, it should be remembered, do not at all represent the export raw cotton trade of China but only the exports from Shanghai.

MANCHESTER OF THE FAR EAST.

Considering the remarkable growth of the local spinning and weaving industry during very recent years, it is only reasonable to expect that the future will see Shanghai developed into the Manchester of the Far East, provided, however, that the manufacturers are given reasonable protection by the Chinese Customs so that they may be allowed to compete on a fair level with the mills of Japan. Given this protection, the possibilities for expansion seem almost unlimited when it is considered that all of China's millions are clad in cotton clothing. That there is ample room for vast increase in the number of power-driven spindles and looms, may be judged from the following estimated figures for the three Far Eastern countries interested in cotton mills:—

	Population.	Spindles.	Looms.
China	400,000,000	1,050,000	5,000
India	278,000,000	6,400,000	28,000
Japan	52,000,000	2,414,544	24,000

CHECKS ON ADULTERATION.

Modern cotton manufacturing was introduced into China in 1890 and was extended after the Chino-Japanese war, considerable foreign capital having been put into local mills in 1896 and 1897. Up to 1902, however, there were no returns on the investments owing to the rapid increase of spindles and the inefficient supply of native cotton which was not equal to the demand, and the fact that the price of raw cotton, because of the shortage, increased out of proportion to the price of yarn. The demand for the raw material, however, was met by increased acreage, and the mills have been more prosperous during recent years.

It has long been the local practice to adulterate cotton by adding water to it for the purpose of increasing the weight. After 14 years of endeavour, in 1911, the Watered Cotton Association was recognized by Peking with the result that the Shanghai Cotton Testing House was organized with an officer attached to it on detail from the Customs. The testing of cotton against water and other adulteration has led to much beneficial results during the past few years. The associated mills, under the rules of the House, are not allowed to accept cotton carrying over 15 per cent. water, and an effort is being made to keep the moisture down to 12 per cent. The natural moisture carried by American cotton is 8 per cent., and in China commonly it is 10 per cent. although some northern cotton is naturally so low as 9 per cent.

Mills Hampered by Taxation of Raw Material.

It is more than absurd that a cotton mill using raw cotton grown in its own country should have to pay more for that cotton than mills in a foreign country for the same raw material—Chinese cotton. That is the equivalent of retarding the growth of home industry while fostering the industry of a foreign and rival land, but it is the taxation situation here in China. Raw cotton to be manufactured in China is more heavily taxed by the Chinese Government than is the same cotton when it is to be manufactured in Japan—and China is a cotton raising country and Japan is not. Here lies the secret of Japan's great growth as a cotton manufacturing country, for the Japanese mills get their cotton duty free.

Mills using cotton growth in the same province in which they are located have nothing of which to complain except internal taxation, but when cotton is imported either from another province or a foreign country, it is doubly taxed. For example, a Shanghai mill wishes to use Shantung, Shansi, or Hupeh cotton: At the port of export the Chinese Customs levy a duty of Hk. Tls.

0.35 per picul and on entry at Shanghai it again collects half duty or Hk. Tls. 0.175 per picul import duty, altogether Hk. Tls. 0.525 per picul. Now, a mill in Osaka purchasing the same cotton from the interior of China only pays an export duty of Hk. Tls. 0.35 per picul, and as it is entered duty free in Japan, the Japanese mill is better off to the extent of 17½ candareens per picul than a mill in China, so far as taxation is concerned. The result is that a very large proportion of the crops raised in provinces where there are no mills is exported to Japan and returned to China as cloth or yarn which might otherwise be made in this country, as mills naturally avoid as much as possible purchasing cotton grown in other provinces.

IMPORTS FROM AMERICA AND INDIA.

Because the native Chinese cotton is a short stapled fibre, the local mills find it necessary to import American and Indian cotton for the manufacture of the finer counts of yarn, and when China's crop is a short one importations of foreign cotton increase largely. When imported cotton is used, as it must be until such time as China produces a longer stapled cotton, local mills are at a serious disadvantage when compared with similar mills in Japan using the same American or Indian cotton. The Japanese mills pay the same price for the cotton but it is entered free of duty in Japan, the Japanese Government years ago having seen the wisdom of fostering home manufactures by putting raw cotton on the free list. When that same American or Indian cotton is entered in a China port it pays a duty of Hk. Tls. 0.60 per picul.

Allowing that 3.45 piculs of foreign cotton are required to make a bale of yarn (three piculs), the following figures show the approximate taxation paid to the Chinese Customs on a bale of yarn spun in China and in Japan, the same foreign cotton being used: Entering China there is levied an

	Hk. Tls.
Import duty on 3.45 piculs raw cotton at 60 candareens	2.07
Excise on yarn at 70 candareens per picul	2.10
	4.17

A bale of similar yarn made in Japan from the same American or Indian cotton when imported into China pays only an

	Hk. Tls.
Import duty at 95 candareens per picul	2.85

A spinning mill in China, therefore, pays to the Chinese Customs Hk. Tls. 1.32 per bale more than its Japanese competitor who ships to China. If there were no import duty on raw cotton, mills in China would be in better position to compete with the mills of Japan. If the duty were lifted, there would of course be a number of additional Japanese mills established in China, but neither Chinese nor European owners of mills here would be afraid of the resultant competition as all would be on the same standing.

A TINY ADVANTAGE.

By the payment of excise at port of shipment the finished product of mills in China is exempt from further taxation in any part of China, and in addition to this exemption China industry is protected to the slight extent of

Hk. Tls.	
0.25	per picul on cotton yarn.
0.04	per piece on plain grey cotton goods.
0.025	per piece on drills and jeans.

Miserable as this advantage is, it assists somewhat, but there are many other products of local mills on which there is no protection, as articles not mentioned in the tariff of 1858 are required to pay the Chinese Customs an *ad valorem* duty of five per cent., which is a severe handicap that does not tend to encourage the development of the cotton mill industry. Yet, the industry is developing in spite of the taxation obstacles placed in its way by the Chinese Government. For example, taking but two mill products, flannelettes and cotton blankets, here are comparative figures of duties paid when Japanese goods are imported, and the duty paid on similar goods made in China:—

	Imports under Mackay Tariff Hk. Tls.	China-made goods pay 5% *ad. val.* Hk. Tls.
Flannelettes, per piece, not exceeding 36-in. wide and 30 yards long ...	0.13	0.18
Cotton blankets, per piece	0.03	0.05

ABOLISH EXCISE.

In order to give proper encouragement to the local cotton mill industry, excise on all mill products should be abolished and all products allowed free access to all parts of China on payment of a nominal fee for a pass at point of manufacture. Raw cotton should be placed on the free list so that it can be imported from foreign countries, or from other provinces, without duty. This would place China mills on a par with those of Japan. If these measures were adopted there seems to be no reason at all, judging from what has already been done by the mills in extending their manufacturing scope, why China should not do even better than Japan has done, for China is a cotton growing country and Japan is not. China may easily turn herself into a rival of Japan as a cotton goods manufacturer if she would adopt Japan's own protective measures. Were that granted, the necessary capital for the establishment of mills would come of itself, without solicitation.

WILL GOVERNMENT EVER MOVE?

There are a great many things Chinese in which it is necessary to arouse interest on the part of the Chinese

Government itself, and not the least important of these is the cotton manufacturing industry of China. The industry needs help in the form of tariff protection, and as Mr. Kerfoot said in his speech before the Shanghai Cotton Anti-Adulteration Association which follows, "We have waited in vain for the Government to move for the last 20 years, and we may have to wait 20 years more before anything is done to assist the industries of this country."

One wonders in this sixth year of the Republic, if Chinese politicians will forgo their personal, selfish wranglings and settle down to do some real constructive work for the good of their country.

APPENDIX.

The Anti-Adulteration Association.

Mr. Jas. Kerfoot, who in the absence of Mr. E. C. Pearce, occupied the chair at the annual general meeting of the Cotton Anti-Adulteration Association on October 10, 1916, after remarking that spinners had waited 20 years for the Chinese Government to assist the industries of the country and were likely to wait 20 more, adumbrated in general terms a scheme, which, if adopted, would assist the mills to obtain a better stapled cotton —by starting seed farms, from which they could obtain a better class each year, and distributing them among the farmers of the district.

In proposing the adoption of the report and accounts for the year, Mr. Kerfoot said :—

"Gentlemen, the report and accounts having been in your hands for some days, with your permission I will adopt the usual procedure and take them as read. The report is fully drawn up and gives the members a full account of the work performed during the year terminating July 31, last.

"There are several features in the report that I should like to call particular attention to, the chief one of interest is the decrease in quantity of Chinese cotton actually dealt with by the Association, which shows a considerable falling off when compared with the two previous years, the totals being 1915-16 piculs 664,486, 1914-15 piculs 794,649 and 1913-14 piculs 943,796, or a decrease of 16½ per cent. from last year's total and 29½ per cent. of a difference between 1916 and the year 1914. This was due in a great measure to the partial failure of the crops in the Shanghai, Tungchow and Taichong districts. The grand total this year includes piculs 219,463 from Shansi, Shantung, Kiukiang, Tientsin and Hankow; also, to meet the requirements of the mills, a large amount of cotton was imported by members from America and India, which, of course, was not dealt with by the Association.

"While on this question of testing for moisture, I regre to say that some of the largest local Japanese-managed mills and all the Chinese mills still refuse to support our efforts to reduce the moisture in cotton from this district, although they have already benefited at our expense by getting their cotton two to three per cent. drier than obtained before the Test-House was started, and if they could be induced to join us we could take a firmer stand and reduce our present standard, which is much too high, and carries with it a great loss to those who have invested their money in the cotton industry of this country.

TIENTSIN'S GOOD RESULTS.

"Many of you are aware of the difficulty exporters of cotton in Tientsin had with excessive moisture some few years ago with the northern cottons, and their losses were such that drastic steps had to be taken and, with the assistance of the Tientsin Native Customs officials, an Association was formed on similar lines to ours, but as the members were all exporters of cotton they had a common interest and were able to get the standard down to 10 per cent., and their working shows the remarkably satisfactory result, on which they are to be complimented, of getting an average of 9.97 per cent., 10.16 per cent. and 10.10 per cent. on the last three years respectively, the weight of cotton dealt with being in excess of that passed through our Testing House.

"Making a comparison with the above figures and ours, although we allow a maximum of 15 per cent. to pass and 12 per cent. as the standard, out of 26,148 cotton samples tested last year 36 per cent. were 12 per cent. and under 12 per cent., 57 per cent. were 15 per cent. or over 12 per cent., 7 per cent. failed to pass. To obtain this result the dryer northern cottons have been included. The average test of the latter was 10.969 per cent. and the Shanghai, Tungchow, and Taichong averaged 12.882 per cent. I will not say that it is possible to get local cotton down to an average of 10 per cent., but when you consider what a serious handicap this excessive moisture in cotton is to manufacturers, we should not be satisfied till we have substantially reduced our present standard.

THE WASTE ON WATER.

"The farmers and cotton brokers have had it their own way for many years. When the mills started early in 1897, cotton was selling at Tls. 12 per picul for the best staples and the cotton was far drier and of better quality than we have ever had it since and the average price has gradually gone up to double what the farmers were receiving 20 years ago. To pay for water at say Tls. 22 per picul is more than any industry can stand. When I point out to you that the average moisture in American and Indian cottons such as our competitors use is nearer 8 per cent., you can realize what a menace to success this excessive moisture means to the local cotton industry.

"To illuminate this matter still further, a mill of 60,000 spindles with a capital of say Tls. 1,500,000, requires 125,000 piculs of cotton per annum: presuming the owner could buy Chinese cotton with an average of 11 per cent. moisture, he would still be paying for 3 per cent. of water as compared with his competitors who are using American and Indian. Taking the price of cotton at Tls. 22 per picul, the amount of water would be 3,750 piculs or Tls. 82,500, being a 5½ per cent. return on his capital. He could import the drier and better cottons from America and India, but here again the millowner has to face a 70 candareens per picul import duty on his raw material, and taking the same weight of cotton the duty would mean Tls. 87,500, or equal to a return on his capital of nearly 6 per cent. Our competitors have no import duty to pay. When the cotton mills were built the intention was to use Chinese cotton and with persistent efforts it may be possible to reduce the moisture and also to improve the quality.

EXPERIMENTAL FARMING.

"In this connexion, you will have noticed, in the accounts that your committee have spent to date, Tls. 481.85 on experimental farming. Our work last year was not very successful owing to the typhoon in July which destroyed a great number of trees. This year's experiments with selected seeds from last year's crop have demonstrated very conclusively that, with careful selection and proper cultivation of the soil, not only can the crops be increased, but the quality can be improved. No doubt you have read the articles which have appeared in the 'North-China Daily News' on the Cotton Industry of China. Your Committee are fully in sympathy with its object of arousing interest in this matter.

"Gentlemen, we have waited in vain for the Chinese Government to move in this direction for the last 20 years, and we may have to wait 20 more before anything is done to assist the industries of this country, but time to us is precious. The mills require a better stapled cotton, and the only hope we have of obtaining this is by starting seed farms, from which we can obtain a better class each year, and distributing them among the farmers of this district.

FOREIGN SEED AND NATIVE.

"We have come to the conclusion that the experiments must be conducted with the indigenous plants, as we find that imported seeds become similar to local seeds in three years. Our attempts with American seed, of which we had ten different varieties sent from the Agricultural Bureau in Washington, which were sterilized and of the best, have not been successful. In the first place, we have too much humidity, and not enough heat for bringing the fruit to maturity; secondly the trees from imported seeds seem to be more prone to attract pests, such as the cotton boll worm, which attacks the leaves, and the boll weevil worm, which seems to lay its eggs in every flower. The worms eat their way from the seeds, and the birds find these and complete the destruction of the cotton bolls.

"I do not think it will pay the Association to spend time and money with these exotics, but I do believe that much can be done to improve the native trees and I have great hopes in the future development of cotton growing in the northern provinces if we can only get the farmers to take a greater interest in their work. With this in view, the China Millowners' Association have decided to have the series of articles on the Cotton Industry translated into Chinese and copies sent for distribution to the Chambers of Commerce in the cotton districts. When completed, an account of the experiments that have been conducted during the last two years will be sent to each member of this Association, and our thanks are due to Mr. Widler of our Testing House staff for his work in connexion with the experiments."